AGU Advances

Peer Review History of

Quantifying Global Power Plant Carbon Dioxide Emissions With Imaging Spectroscopy

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Author Response to Peer Review Comments

Peer Review Comments on 2020AV000350

Reviewer #1

This manuscript provides a novel and exciting description of the use of remote sensing to quantify point emissions of GHG's from power plants. The authors conclude that the capability exists and that planned missions could provide adequate capacity to quantify a substantial portion of the global GHG emissions from power plants. My comments in the attached file seek to clarify a number of points, but I am supportive of the manuscript and feel that it warrants publication.

Mike Kuperberg

Please see the attachment that begins on the next page.

Cusworth et al., “Quantifying Global Power Plant Carbon Dioxide Emissions With Imaging Spectroscopy”

Review comments from Mike Kuperberg, 1/5/2021

Line	Comment
18	The authors should clarify that parts of this analysis address coal and gas-fired power plants (the U.S. analyses) while others are restricted to coal-fired power plants (the international analyses). (see, for example, lines 24 & 27 that suggests all were coal-fired). Further, there is a confusing mix of coal-fired, gas-fired, and unspecified “power plants” throughout the text.
23 & 209	The reference to “supply chains” seems like an overreach for this study. The authors provide one example of connected coal mine/power plant – and that is a nice example. However, it is a stretch to make statements about the applicability to entire supply chains based on one limited example.
57	Would like to see citations for the two conclusions in this sentence.
69	The comparability of the two U.S. approaches seems to be remarkably close which seems odd when the authors characterize reporting as faulty or divergent.
97	Assume the authors mean “power plants”? This seems to be the first description referring to both coal and gas-fired power plants.
116	Does this mean that the EPA/EIA estimates are much closer to each other than to the remotely sensed values?
117	Should clarify that Fig 1a uses GAO
117-123	This section is hard to follow. Is the PRISMA/GAO discrepancy from the same time or are the authors comparing observations from two different months. Is the “simultaneous CEMS” measurement from June or July? Four Corners Power Plant shows dates, but not values, while Intermountain Power Plant shows both dates and values.
138-139	With the small sets of observations available it seems unjustified to blame the discrepancies on faulty CEMS data.
162	“between” should be “among”
164	Having shown that the U.S. does “reliable reporting information”, the authors should be clear that they are targeting non-U.S. countries.
174	This section seems to be limited to only coal-fired plants. Is the GEM data limited to coal-fired power plants? Should line 173 say coal-fired power plants?
180	Is the Hunter Power Plant known to be the lowest emitter that can be quantified by PRISMA or was it the lowest-emitting power plant that was analyzed? I.e., is it possible that lower emissions rates could be measured by PRISMA?
186 & 190	These sentences should refer to Figure 4.

223 The authors probably mean “thank”

390 The fuel types for these two U.S. power plants are not specified in the figure, while the international power plants in the next three figures are specified.

401 Should “exist” be plural?

Reviewer #2

This manuscript describes the 'first demonstration of high spatial
100 resolution, globally-scalable, CO2 facility-scale emissions estimation from remote observation.' It is well-written and shows promise in terms of applicability for timely actionable science and observations for critical climate change mitigation decisions. It should be published as soon as possible. My comments below are minor.

Could you explain how the facilities are included? How did you chose them? i.e. the criteria and whether/how they/the local stakeholders were/are included before and after the study?

End of page 9
'The joint CO2 and CH4
209 sensitivity of imaging spectrometers allows us to quantify supply chain GHG emissions, opening
210 the potential to do fuller carbon accounting of energy supply and industrial processes. Ultimately,
211 for carbon mitigation measures to be effective and validated, robust understanding of actual
212 measured CO2 emissions from these facilities is required. This is possible through coordination of
213 current and future airborne and satellite remote sensing missions.'

-- Please list all pertinent current/future airborne and satellite missions
-- Do current supply chain carbon/GHG emissions accounting utilize imaging spectrometer data? How could this data be embedded in the supply chain accounting in the future? Provide example please, even if it's hypothetical or a concept model.
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Comment on Abstract:

'Reporting programs, such as the IPCC National Greenhouse Gas Inventories, have latencies of 12-24 months and may not keep pace with rapidly changing infrastructure, particularly
in the developing world.'

-- remove 'IPCC'. Could just state 'National Greenhouse Gas Inventories'

Thank you. Excellent research.

Reviewer #3

Please see attachment that begins on the next page.

Review of AGU Advances 894973 by Cusworth et al

The manuscript describes an approach and demonstrates utilities of airborne and space-borne spectrometer in estimating energy facility emissions. The remote sensing estimates are compared to measured values at the facilities. The use of remote sensing spectrometers is expected to enhance GHG monitoring and improve global GHG budget. The comments below refer to the main text and figures. I read but have no comments for S1. I also did not check for references.

General comments:

Line 64 statement "possible data manipulation" is uncalled for. So discrepancies in China between CEMS and satellite estimates could be a possible data manipulation but mismatch in US between the same uses (e.g. Fig. 1, last two data points) is not? It seems to me there is no benefit to your case by speculating without evidence. Whether it was manipulated or not and in which country, it does not diminish the need for remote sensing-based estimation.

I also do not understand the need for devoting significant space (e.g. lines 169-183) discussing differences between Annex I and non-Annex I countries. Is it because the developing countries do not use CEMS? The authors are not proposing to use the system to monitor only these countries, so what is the point of focusing so much on the difference? The world has moved on from Kyoto, justifying for the new remote sensing system in context of an old arrangement could lead to future detection and monitoring biases. Why not just focusing on proposing a consistent and complete coverage no matter where the facilities are located?

Authors confused figures 2, 3, and 4 in text.

It would be good to add discussion for using the remote sensing technologies in GHG monitoring and global GHG accounting and understanding of uncertainties due to either of the two systems. Where are sources of uncertainty in remote sensing estimates?

25: The sentence "Satellites allow …" could be revised for clarity, such as "Satellite spectrometers could track high emitting coal-based power plants in the world that collectively contribute to 60% or more of CO2 emissions globally"

49: Delete one of "such as the".

49: IPCC is not a reporting program but provides guidance to it. Please revise.

57: "Point sources are a driving factor in these discrepancies, …" – You showed that point sources are the largest GHG emissions, but that is different from being the major factor in discrepancies. It would be good to show this point by citing a reference or two.

79: Delete "pixel".

91: What does “operator intervention” mean here?

106: How could a pixel contain CO2 concentration?

117: Explain that Fig 1a is derived from GAO here? Also it would be useful to add date as part of title for both 1a and 1b.

132: Report CEMS magnitude of increase in the sentence please.

136: “… airborne and satellite observations are consistent with one another,” – So far you have not shown the remote sensing platforms are consistent with each other, you have shown, largely, they are individually consistent with CEMS.

140: Figure 1c not 1a.

147: The equation should be referenced, perhaps to a sampling book?

168: Caption of Fig 2 only mentions the two Indian power plants.

173: IPCC is mentioned earlier.

175: Fig 4 should be Fig 3. Recommend adding the bold phrase in the end of the sentence to make the statement clearer to read: “…as well as the percent contribution to the global total coal CO2 emission **by emission levels** (GEM, 2020).”

179: “smallest” ➔ “lowest”?

182: Delete the first “use”

186: Figure 2 ➔ Figure 4

190: Figure 2 ➔ Figure 4

203: It should be noted that the 21% value is an average, the range of differences can be as high as 40-50% judging from Figure 1. I would recommend that both the mean and range values be given, and discussion provided on uncertainties as well as opportunities to improve using the two systems.

208: “fossil” ➔ “fossil fuel”

211: The word “actual” is not needed. Measured is actual.

212: “This is possible …” Does this statement suggest that the proposed airborne and satellite missions are equivalent to “actual measured CO2 emissions from these facilities”? Measurements are done *in situ* whereas remote sensing provides observations and estimates. Let’s not mix the two concepts.

400: Add caption for 2C and 2D.

410: Should “for” be “from”? “… a certain threshold or greater” is a confusing phrase. If it is of greater value, shouldn’t the red dotted line be a flat line?

417: Should it be “carbon and greenhouse gas”? Or just “greenhouse gas”? Otherwise, carbon greenhouse gas does not make sense.